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CMC: New Designs for Learning

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Computer-mediated Collaboration:
New Designs for Learning
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Computer-mediated Collaboration: New Designs for Learning

Objectives

The unprecedented feature of educational applications of computer conferencing is the potential for facilitating collaborative learning independent of time and place. Computer-mediated collaborative learning involves asynchronous, distributed, text-based and computer-mediated interaction and thus presents new opportunities and challenge for educators.

This paper[1] presents a case study analysis of the use of computer conferencing for delivery of formal group learning activities (electronic seminars, online learning partnerships, working groups, and debating teams) within two graduate level courses. The courses were offered entirely online, as regular 12 week credit course offerings. The paper focusses on design issues related to computer-mediated collaborative learning, specifically: 1) the design of online learning groups; 2) the rate, volume, and patterns of learner participation and interaction; 3) nature of cognitive interactions in online collaborations; and 4) user identified issues related to online collaborative learning.

The paper concludes by discussing the specific nature/characteristics of computer-mediated communications for collaborative learning and proposes a framework for addressing research and development in this growing new domain of educational activity.

Theoretical Framework

Collaborative or group learning in the traditional face-to-face classroom, refers to a set of instructional methods in which students are encouraged or required to work together on academic tasks (Johnson & Johnson, 1975; Slavin, 1986).

Studies in collaboratively structured learning have found that this approach tends to promote higher achievement that do competitive or individualistic learning situations (Johnson, Maruyama, Johnson, Nelson & Skon, 1981). Research at elementary, secondary and higher education levels has demonstrated the effectiveness of collaborative group approaches (Johnson & Johnson, 1982; Sharan & Sharan, 1976; Slavin, 1983; Webb, 1986; Bouton and Garth, 1983). Peer collaboration has been identified as a hallmark for learning at post-graduate level (Queen's University, 1975) and central to the nature of adult educa-

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[1]I gratefully acknowledge the assistance of Catherine Chandler-Crichlow and Judy Weinstein for their research assistance in this paper.

tion (Brookfield, 1986).

Collaborative learning theories view the learner as an active participant in the learning process (Bouton and Garth, 1983; Whipple, 1987). If active learner participation and group interaction are key factors in collaborative learning (Sharan and Sharan, 1976), then the computer conferencing environment suggests an appropriate context. By providing opportunities for time- and place-independent group interaction, computer conferencing expands access to learning peers who can provide affective as well as cognitive supports for the learning interactions.

Research on educational applications of computer conferencing is only beginning and much work is required to understand this newly emerging domain of educational activity. Studies to date have found that the medium has certain advantages over traditional distance education programs (Deutschman et al., 1985; Haile, 1986; Kaye, 1986); as well as over classroom education (Hiltz, 1986; Harasim, 1987). Existing research has focussed on user characteristics as a factor in successful online interaction (Hiltz, 1986); on volume/patterns of online learner participation (Harasim, 1988); and on analysing learner interactions (Levin, 1988).

However, there is no research into the design of online course activities, specifically the use of computer conferencing to facilitate learning collaborations, and the impact of these designs upon the learner. Understanding the experiences of the learner in this new, largely unexplored educational domain, is an important area which requires attention by educational researchers.

Methods and Data Sources

The Ontario Institute for Studies in Education[2] has, since 1985, used the Participate computer conferencing system to deliver credit and non-credit courses entirely online.

This paper presents data collected from field research on OISE's online courses. Group learning methods used in two online graduate level credit courses are described and analyzed. The courses were the same (using the same curriculum and group learning approach) but were offered in two different sessions. All activities occurred via computer conferencing, in which the students communicated with one another and with the instructor through their microcomputer and modem. Students were located in Central Eastern and Maritime Canada, collaborating asynchronously via the text-messaging medium of the computer conferencing system. The first course had 28 students, while the second course had 19 students.

Both quantitative and qualitative data are presented. Quantitative data include system generated usage data (volume and rate of user participation) for each group learning activity as well as analysis of users responses to four sets of online questionnaires sent by the researchers to each student in each course. Each questionnaire explored a different aspect of the online experience, ranging from technical problems to issues related to the online group learning design. Qualitative data include participant observations and user reactions to the group learning activities which were collected from informal course conferences es-

[2]OISE is the Graduate School of Education of the University of Toronto.

tablished for this purpose.

Online Collaborative Design

The concept of group learning, online and/or face-to-face, encompasses various types of interactions: differing group structures and sizes, various task structures (some producing products, other for topic exploration), reward structures, timelines, etc. In the online course activities described here, collaborative learning activities included those with specified tasks (i.e., an assignment to produce a report or class presentation) as well as group activities without specified products (a discussion group where mutual exploration was the task, without need for consensus and development of a single product). Moreover, some group activities had explicit rewards (i.e., a grade) while others did not have an external reward structure. Size of group was another variable: these varied from dyads to working groups composed of four participants, while the seminars and informal discussions included plenaries where all participants (up to 30 class members) would engage. Time available for an activity was a further variable.

The course design analyzed here involved five different group learning activities. (See figure 1 for an overview of the Course conference layout.)

****Figure 1****

The five group learning activities are:

Online Seminars: Online seminars are group discussions organized as a series of one or two week session, each session focussing on a specific topic. Students read assigned text materials (offline) and engage in discussing, debating, and analysing the issues online, within the computer conference(s) established for that topic. Two forms of seminars were used:

1. Plenary sessions (involving the full class);
2. Small group sessions: each small group focussing on a specific subtopic.

Learning Partnerships (Dyads): Online partnerships in the form of dyads are used for producing an assignment in which the partners work together, using a conference space and/or e-mail to produce a short report or analysis which is then presented to the class. Dyadic assignments involve a reward structure (i.e., a grade for the assignment). Dyads are also used in some cases to provide peer support--technical and motivational--a kind of ice-breaker or buddy system when students are not yet familiar with one another. Such use of partnership does not involve extrinsic reward structures.

Online Working Groups: In online working groups, students undertake small group assignments for research or fieldwork activities and then report the results in an online class presentation. Groups are typically comprised of 4 members. Like dyads associated with assignments, a group reward structure distinguishes activities in this phase: interdependence among the members of each group is structured by the mutual goal (the class presentation) and mutual concern for achieving it (a group grade). Working groups have approximately 3-4 weeks to produce the assigned report.

Team Debates For the team debates, the instructor pairs the students into teams and assigns a 'yea' or a 'nay' position on a topic which the student is to argue and defend. Students should base their arguments as much as possible on class discussions to date (i.e., by analysing the transcripts). In this way students are encouraged to make multiple passes through the transcripts to critically interact with the content and build their knowledge base. A team debate is usually 3 weeks in duration: one week for preparation of the presenting argument; the second week for rebuttal to the opposing member; and the third week for developing a final "balance sheet", in which the person's own views are presented. A grade for the debate is also assigned to each participant. This task is group interactive insofar as each person is interrelated with his or her debating team member in terms of some of the content and interaction but not in the reward structure.

Informal Discussion Groups: Informal group discussions form an essential part of the online class interactions. Unlike the four previous activities, informal group discussions are not time-specific: they continue for the life of the class. They are supplementary, in a very important way, to the "core" activities. Such conferences as "coffeehouse", "learning log" "library" and "assist" provide community building, access to supplementary resources, and user support. They are typically full group conferences, providing an ongoing link among class members.

Analysis of Learner Participation and Interaction: Cognition and Collaboration

Reports of learner participation and interaction described here comment both on the volume (quantity) of participation and on the nature of the cognitive interactions.

Volume of Learner Participation

System-generated usage statistics were gathered on the number of messages sent to the conferences. Two measures of volume in online communication are the number of messages and number of characters. Winkelmans (1988), analysing message flows in educational computer conferences, found that the Pearson correlation coefficient between the two, based on the discussion groups' individual daily totals of messages and of characters, is very high (r=.94). As he notes, since counting the number of messages is easier than summing the character counts of all messages (provided in the message headers) the number of messages is a good practical approximation to writing activity (Winkelmans, 1988, p. 110).

The number of messages is thus used here to offer insight into the volume of participation in the various group learning activities. These statistics are analysed as percentage of the overall messaging for each course as well as averaged to show per user messaging per type of group activity.

Figure 2 presents percentage of messaging per type of activity in each of the two years. The volume of messaging seems fairly consistent between the two years, suggesting that such factors as overall group size or particular demographics have less of an impact than the nature of the activity, the particular activity group size, and/or the length of time available for each activity. The lowest total volume of messaging was generated by the course evaluation which occurred at the end of the course, with only one week for input. The highest total volume was the informal/social discussion group, which was available the entire 12 weeks of the session. Both involved a full group (plenary) discussion.

More research is required to examine how nature of the task, group size, and length of the

conference time affect the messaging volume.

****FIGURE 2 About Here****

Figure 3 uses the same data to generate information on the average number of messages sent per user per activity (the total number of users in each course includes the instructor). The average messaging per user reflects similar pattern to that seen in Figure 2.

The messaging volume presented in Figure 3, while an average figure, shows that participation was active...students were active in each of the group activities, sending many notes per week. This pattern can be contrasted to most face-to-face classes, in which the majority of students are silent.

Another notable feature is that the volume of messaging in Figure 3 is similar for both courses. And the average number of messages sent per user per week is very close. This despite the fact that the demographic composition for each class was quite dissimiliar: the first course was comprised of primarily female students, while second course had a majority of males. The first course was mostly master's level part-time students, while the second course had more doctoral level and full time students. The first course, moreover, had approximately one third more students. From this small sample, it seems that such factors as group composition and/or size may not be particularly critical factors affecting messaging volumes and patterns in online groups, whereas nature of the task and/or amount of time for conducting the task do seem to impact upon messaging activity.

****FIGURE 3 about here.****

Hypertextual Transcript Analysis of Learning Interactions

The quality or nature of the learning experience was analysed through a new technique that we are developing at OISE entitled "hypertextual transcript analysis" (Harasim & Crichlow, 1989; Wolfe, 1989).

Hypertext and information management programs (Storyspace for the MAC and IZE for the IBM) were employed to analyse selected group interactions within the online courses. Here I discuss hypertextual analyses of two group designs: a plenary session and a small group seminar. One conference representing each learning strategy was selected for analysis: both conferences came from the same course, so that user characteristics were identical.

Hypertextual Analysis of an Online Plenary Seminar

Hypertext systems were used to analyse a plenary group seminar to determine the impact of readings for guiding online discussions, the nature of the cognitive interaction among participants, the development of the discussion on concepts raised in the conference, the manner in which notes were referenced in the conference, the development of common interest subgroups within the conferences, and individual use of messaging.

The conference selected for analysis was a plenary seminar which involved 23 participants, including the course instructor. A total of 127 messages were sent to the conference, which ran for two weeks (it ran parallel to several other conferences for this same group). This

was the first "core" activity for the course, and occurred in weeks 1-2 of the 12 week session.

Content analysis identified 22 thematic categories that arose in the conference: 6 themes were derived from the readings, 16 were generated by the participants. Process analysis (coding the interactions in the conference) showed that 139 perspectives on the themes were raised by participants in the course of the discussion. Of these 88 were related to the readings, while 51 discussed themes raised by the conferees. Thus, interaction was centered upon and clustered around themes derived from the readings, although the discussion broadened to include new themes and perspectives.

Cognitive interactions used by the participants in the conference were coded and tracked using hypertext systems. We began by fine coding observable skills in the selected conference. The following 25 labels were used for the coding: question, elaboration, acceptance, illustration, new point, synthesis, +positive reinforcement, -negative reinforcement, catalyzing, exemplification, generating hypotheses, abstraction, clarification, summarization, extrapolation, substantiation, agreement, answer, disagreement, states position, new perspective, formulation, modification, interpretation, course procedures.

The most common type of interaction was *elaboration*, which occurred 35 times in the conference. The second most commonly used interaction was *introducing a new perspective*, with a total of 31 occurrences. There was no fixed pattern in the use of the different cognitive interactions over the entire conference.

The use of hypertextual analyses for investigating the themes discussed and the cognitive interactions that occurred on these themes showed two modes of referencing: *direct referencing* (notes making specific reference to previous notes, either by specifying message number(s), sender's name, or keyword) and/or *implicit referencing* (implied but not directly specified references). Through analysis of the notes directly referenced, two main trends were noted:

1. Procedural notes sent by the instructor were the most frequently referenced. Student notes which emanated from the procedural notes were elaborations, formulations or syntheses of perspectives previously sent in the conference.

2. Notes which introduced new themes were the second most frequently referenced messages in the conference.

This outcome suggests that there is greater attention given by participants to messages in which new themes have been introduced, at least insofar as evidenced by the quantity of intermessage referencing. However, more research is need to determine how other factors such as *language used in the message; the cogency of the arguments stated; the persuasiveness of the stated perspectives;* or *the relevance of the issues to the user* impact upon the interaction of other participants.

Tracking of *logical references* used in the conference based on the theme discussed showed that small subgroups developed within the larger group. These subgroups clustered around common themes. Once these subgroups were developed there was on-going communication among participating members. A comparison of the pattern of discussion of themes over the entire conference showed that there was random referencing to the themes throughout the conference.

Participants could also be categorized according to messaging styles. Two main categories were identified: 1) those who sent single theme notes (each note contained one main

theme). This group of users accounted for the bulk of the messages sent online and 2) those who addressed several themes within a single note. These were in the minority; however, they discussed the same number of themes as the first group---using fewer notes. Areas for further research are:

- Does message size impact upon the interactive process in online education, and if so how?
- How does messaging style impact upon the group dynamics? collaborations? cognitive and affective interactions? perceptions by the group of the sender?
- How does offline/online preparation impact upon messaging style? message size? For example, uploading and batching files results in clusters of message from each sender. This may impact upon the flow and dynamic of communication in a conference.

Hypertextual Analysis of Small Group Seminar

Hypertextual analysis of a small group seminar was conducted on a conference involving 12 participants who sent a total of 72 messages over one week. The focus of the session was discussing the role that computer conferencing could play in university education. For this seminar all participants read research papers on the topic and then discussed key issues within the computer conference.

Content analysis identified 15 themes raised in the conference: 4 came directly from the readings, 11 were ancillary to the readings and were generated by the students in their discussions. The 15 main themes were discussed in various ways 108 times in the 72 messages: 31 of these occurrences referred to themes related to the readings, while 77 related to themes generated by participants. This is the reverse of the findings from the plenary group, in which the discussion generated more perspectives related to the readings than to themes raised by participants.

A review of the message flows over time indicates that initially in the conference participants *introduced new points or positions; asked questions;* or *gave new perspectives.* Approximately midway, such processes as *elaborations, extrapolations, substantiations, clarifications, agreements, illustrations, and acceptance* characterized the cognitive interactions. Towards the end of the conference, the main strategy was the *synthesis* of previously discussed perspectives and issues. This pattern may be linked to instructions from the from the course instructor, or do the nature of the task or increased comfort/skills in conferencing by participants (this activity followed the plenary), since similar patterns were not observed with the plenary discussions, where the synthesis phase of activity was not reached.

Some issues for further research are:

- Does the size of the group affect the manner in which the information flow and cognitive interactions used throughout a conference?
- Are differences in the interaction patterns related to group characteristics or are they a result of the characteristics of themedium? if so, which characteristics? and how?
- Do the social dynamics in a small group differ significantly from a large group in an online conference and if so, how do these affect the manner in which various cognitive and affective interactions occur throughout the conference?
- Do other factors such as the time available for the participants to respond and

interact facilitate movement to higher order interactions on ideas?

The classification of users into those who sent one message dealing with many themes and those who sent responses on many themes each in a different message was also identified in the small group seminar. Also, those participants who formed learning groups in the plenary session and who were participating the small group discussion, again formed online subgroups. Further research areas for exploration are to determine whether:

- Participants are consistent in their mode of interaction regardless of the size of the group or other factors which might impinge on the communication process.
- Learning associations developed in such structured learning situations are similar to those in less structured conferences such as the informal discussions.

Issues Related to Online Learning Collaborations

Analysis of user feedback identified a number of issues critical to online collaborative learning. Here I discuss the present user reactions to the online collaborative learning designs.

User Feedback to Collaborative Activities:

1. **Face-to-face**: An (optional) initial fullday face-to-face session was offered to introduce the students to the curriculum, to the conferencing system, and to one another. Most students attended, even from great distance. Students reported that the face-to-face session helped to create the sense of group (and of the instructor) prior to the course, and contributed to building a group dynamic.

2. **Electronic seminar/full group (session 1):** The first online session is a full group (plenary) seminar. User feedback indicated the importance of such a full group initial session as an "ice breaker", developing a sense of group and introducing individuals in the group. The nature of the discussions, such as debates, etc., helped ease users into the medium and the course by focussing on topics somewhat familiar to the learner. The instructor started the course with a debate about a controversial topic that most participants would likely have formed some opinion about: this motivated new users to make the transition to the new mode of communication and interaction, overcoming technical frustrations. On the other hand, in a large size class (20-30 people), a plenary can generate an "overwhelming" amount of information. As an initial activity a great deal of information may compound difficulties faced by new users, who are possibly still learning how to handle the technology and possibly experiencing some technical difficulties. It is also true that new users may be somewhat lost initially and send notes to the wrong conference, with the result that others may feel confused or annoyed at the misplaced messages. User comments ranged from perceiving the first plenary conferences as being "the most effective collaborative environment" since they included the full group, to having "too many people".

3. **Electronic seminar/small group discussions (session 2/3):** Seminars were based on discussion of key themes related to the readings. Students noted that electronic seminars, with associated readings, were an effective way to begin, since structure and focus was provided.

4. **Learning partnerships (assignment #1):** Several comments were made

that this assignment is very appropriate as an introductory collaboration because its scope and group size is manageable at an introductory level: "Very helpful to reduce the group to 2 persons for the first major collaborative assignment". Commented another: "A focus helped overcome the initial shock of using the computer as an aid to communication. Also it was useful to be given source readings that provided expert views about the technology. The problem became apparent that in some instances that one person 'carried the ball' and this happens in all situations". The overwhelming majority of respondents were positive; the negative comments all hinged on frustrations with the nature of the partnership or collaboration in general (i.e., working with a partner who was perceived as resisting changes, who was perceived as not sharing the workload, or who had opposing views with little perceived room for negotiation.)

5. **Working Groups (assignment #2):** As a collaborative effort, this assignment was viewed as successful by most participants. "Assignment 2 was a delight. I saw my fellows actively participating in my explorations and myself adding to theirs." The importance of sharing of workload was identified by several participants, as "facilitating the examination of a system in greater detail than one person". Another noted: "This assignment was more successful because of the slightly higher number of people, I feel." "A natural progression to collaborate with a larger group", commented a third. "The exercise is a good one, for learning online coordination techniques". This issue of *online coordination techniques* emerged as key to this group strategy. The amount of time available was important here, since "it also took some time for the group to organize the work". Respondents with experience in previous online courses felt that they were more successful because "we were more experienced with the organizing that must take place for this type of assignment". Forming groups was hectic, and some participants noted that they searched for a group "upon whom I could rely." The issue of dependable group members was raised again for this assignment, since at least three people noted that some group members gave considerably less effort to the task. One person noted that it was difficult to critique questionable content online, with no non-verbal cues.

6. **Debating Teams (assignment #3):** Students generally enjoyed the debates, reporting that having the team, the topic, and the position assigned reduced the time required for sorting these issues out and enabled increased attention to developing the presentation. Also, the fact that students were required to defend a positoin that they likely did not endorse was aprpeciated by the majority. "I liked the positions being assigned...it forced us to consider the other position...interesting way to synthesize the learning experience." "It was fun trying to sit on the other side of the fence and support something that I didn't believe in." Students commented that the "debate activity helped to synthesize content", since they were required to reread the transcripts to suport their case. For many--perhaps most--respondents, having an activity which was more individual in design and presentation was appreciated; perhaps they appreciated the break from full collaboration. This task allowed more individual control over the product. However, one of the negatives associated with this activity, particularly the need to conduct indepth searches of the transcripts was the increased telecommunications charges.

7. **Informal Group discussions ("coffeehouse", "assist", etc.):** The informal conferences were generally viewed positively, some even going so far as to

describe these conferences as the "most collaborative as evidenced from the ongoing dialogue." REspondents commented on the "coffeehouse" fulfilling the need to socialize, noting that "one actually had the feeling of being in a crowded room with lots of people chattering around you while enjoying the company of others." Users found that informal conferences facilitated group interaction since "you can work more effectively in a group if you know how your partners tick". Another felt that informal socializing gave "personality to the names on the screen". Even those who didn't participate much enjoyed the informal conferences. One person got alot of nods and chuckles from these and felt that there was a greater camaraderie than with face-to-face classes. This person lurked but still enjoyed the atmosphere and felt a part of it. There were some respondents who didn't participate in the socializing conferences and in a few cases felt that it was dominated by a handful of participants. REgarding the other conferences such as the library, while this conference was not used very much, nevertheless students appreciated the convenience, "an excellent resource at your fingertips."

Collaboration online was reported as successful in terms of product and process. However, several specific issues were identified as contributing positively and negatively to the experience.

The first relates to the differing experiences of collaboration: in some cases the dyads or groups functioned very smoothly and reported the experience to be one of the best in their graduate experience. In other cases, participants reported such problems as inequitable distribution of responsibility for the task, and difficulties in group process such as decision-making.

These responses relate to the very essence of collaborative learning, rather than reflect on the attributes of the medium or its specific design. A few students expressed concern that group work might negatively impact on the quality of the final product, perhaps dilute or alter it to produce an inferior product. the following quote from a student characterizes this concern:

> When I am in control of outcomes, I have no trouble doing/publishing anything. When I cannot control the quality of the outcome, I am in deep emotional trouble...I am a very good writer and a very good speaker, consequently if written work is to bear my name, I want to control the shape and form of the final product...

> The quality of the experience has been superb, because I have not only learned a lot in a content sense, but I have learned alot about myself. (The group projects) all "worked" well toward the success of the experience. I had, but no longer have, some problems with the reward structure---read marks---when I realized that my mark as going to be predicated on the joint effort in certain cases with partners over whom I could not exert creative control. This learning to negotiate online is taxing. Then again, that is the real exercise: online negotiation. -a Student.

Other issues specifically related to computer conferencing as a medium for collaborative learning were identified.

Online collaboration is unprecedented and there is much to be learned about effective interaction.

Other Issues:

1. **Group Size:** Group size is an important factor in online collaboration. For a learner-centered collaborative activity, a group of 25-30 participants was found to be overwhelming, particularly if each participant was active in inputting notes. In the larger class (with 28 members), the use of subgroups was reported to be very effective, by reducing the volume of interaction to more manageable proportions for interactivity. In the class of 18 students, the general response was that the group design and sizes functioned effectively: "for each activity the group size was right!" However, some users offered additional comment, for example, the need to have at least 3 or 4 participants in a small group assignment. The initial plenary sessions might be too large a group, perhaps for an initial activity. On the other hand, others found it effective to begin with the full group.

2. **Nature of Task:** Students were highly positive about the nature of the tasks which they felt all "worked toward the success of the experience". Having a variety of tasks was also appreciated. Students commented that having a combination of group and individual tasks was effective (and that at least one assignment should be individual).

3. **Division of labour:** Division of labour or group roles is an important issue in collaborative activities since it defines how the work is conducted. Group roles were not designated by the instructor but were decided upon or negotiated within each group. In some groups, members shared the various tasks and cooperated on designing the final product. In others, each member undertook one aspect and the final product was "stitched" together. This latter form seemed to be less satisfactory from the point of view of the participants. For some learners, the team debate was most satisfying since each person was responsible for his/her own work.

4. **Timelines:** One of the issues in online group work is the amount of time available to complete an assignment. Asynchronicity definitely impacts upon the process of collaboration and seems to require longer time allowances for project development and decision-making. Another factor is that in a larger class, there is higher volume of messaging which requires increased time and effort on the part of each student to process. A third factor relates to technical problems, particularly initially as the new user is learning the system. This period requires a significant outlay of time and effort, in addition to that required by the curriculum.

5. **Reward Structure:** Reward structure here refers to the use of external rewards such as grades. Students (and the instructor) noted the difficulty of grading collaborative assignments particularly if there had been unequal input into developing the group product. A few students expressed concern that their mark may have been lowered because of the perceived inadequacy of a partner. Grading collaborative assignments may in some cases be counterproductive since it emphasizes product over process. Students also mentioned that allocating some portion of the grade for participation might contribute to a focus on quantity over quality. (More than half of the students said that their reward from the course was intrinsic, derived from an environment in which feedback from the instructor and peers was prompt and available. "I could almost feel learning taking place.")

6. **Group Formation:** Students were generally positive about the process of

group formation within the online environment, and felt that "there was a good balance between self-formed and instructor-formed groups for the various activities." There were problems. As one student noted: "Group formation is always tricky and even more so in an online course...". The problems were especially related to the asynchronicity of the medium, lack of real time communication protocols and opportunities. The difficulty of establishing partnerships which involve negotiating with a user who may not come online for the next few days, only to discover that that person had already joined another group. Such problems are exacerbated in a context where an assignment has a due date. It is also difficult to form groups when learners are not yet familiar with one another, and common work habits, interests, etc., are not yet apparent.

7. **Moderator Style:** One of the factors affecting the online interactions and learning was the style of the moderator. REceiving encouragement and prompt responses was appreciated by the students and served to motivate participation for many. "I like the way the instructor encourages everyone and expresses appreciation for their efforts and helps to solve problems. This is almost unique in my graduate experience." In addition, the moderator provided the design and focus for the interaction and also monitored the conference to ensure that the discussion remained on topic and that misinformation was not being presented. Overall, the moderator maintained a relatively low profile (in terms viewed as the quantity of messages) but was available regularly. The moderator was important not only to the content of the discussions but to the process issues as well, such as "limiting input of overly vocal participants, ensuring relevance of notes, and encouraging use of personal notes where appropriate." The moderator should also "encourage the quiet to participate". Learners commented that a key task of the moderator is to ensure focus to the discussions through frequent weaving (summarizing) comments in a conference (or by assigning this task to one or each of the participants).

8. **Group Dynamics/Decision-Making:** Group dynamics online, as off, can be both exhilirating and problematic. As one student noted: "The group decision-making seemed to vary based on the nature of the task and the group members. Very true to life!" However, the nature of the medium did influence this process. Students noted that as a result of the asynchronicity, they were able to get to know one another far better with more satisfying group dynamics that in typical f2f environments. On the other hand, decision-making was affected both positively and negatively. In some cases asynchronicity was a factor contributing to a more thorough discussion of ideas, more of a consensus decision-making. In others, asynchronicity impeded timely decision-making.

9. **Information Management:** Threading of comments is difficult online. Although the course design was based upon a fairly complex topical tree-structure (with 40 conferences in one course, and approx. 60 in the other), nevertheless, within each conference new themes would emerge. The use of hypertext as a user interface was discussed as a means for user-directed organizing and structuring of the discussion threads.

10. **Prerequisite Technical SKills:** All students agreed that the ability to up/download files facilitates coursework and group interaction Downloading saves reading on the screen, time, and telecommunications costs. Uploading enables reflecting on ideas, composing and editing responses, and contributes

to more critical and thoughtful learning interactions.

11. **Technical Problems:** A major issue in learning online relates to technical problems. 58% of the problems cited by users in the questionnaires related to technical difficulties (up/downloading accounted for 25% of these). Technical problems did not affect the majority of participants, but for those who did experience technical problems, there was a negative impact on their learning interactions. For these, technical problems increased the amount of time required for the course. Technical problems were distracting and/or frustrating. Students noted how much more enjoyable the course interactions were when all the technical difficulties were overcome.

    a. Effective Use of the Parti cc system:

    b. Effective Use of Communications Software:

    c. Telecommunications:

    d. Time Commitment:

    e. Cost:

    f. Effects of the Medium on Learning: Metacognition and Interaction

Conclusions

The major conclusion drawn from the research described here is that computer conferencing, a many-to-many communication medium, is conducive to group learning activities and can support, facilitate, and encourage active learning. Results of the data analysis showed with careful attention to design high, equitably distributed rates of learner participation and interaction.

Analysis of user reactions identified both benefits and problems with text-based, asynchronous, and distributed group learning, but students reported that overall the advantages far outweighed the difficulties and that they would take another online course. User satisfaction was high.

Examination of specific collaborative learning approaches employed by the courses revealed certain strategies to be rated by users as particularly effective and successful, while others were found to be difficult to coordinate online.

The user feedback and analysis of usage data have implications for the design of future online group learning activities. Important issues identified for online course design include size of group, online group dynamics and decision-making procedures, nature of group task, nature of group reward, time available, and role of the instructor. Additionally, the paper presents conclusions and recommendations related to the nature of the medium for facilitating information management and organization.

Educational Implications

Online group learning introduces a new domain of educational interaction. This paper provides data that can guide research and practical developments in this domain. Additionally, this paper contributes towards the development of a conceptual framework that can guide research and practical developments in this rapidly growing new field of educational activity. It also suggests ways in which parallel but converging advances in other sociotechnologies such as hypertext and computer-supported cooperative work systems might enhance and expand the effectiveness and scope of computer-mediated collaborative learning.

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